Bibliometric mapping of top papers in Library and Information Science based on the Essential Science Indicators Database

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ABSTRACT

This study analyzed top papers published in the field of Library and Information Science (LIS) published between 2009 and 2019 and included in the Web of Science (WoS) subject category "Information Science & Library Science". Data of the 501 top papers were extracted from the Essential Science Indicators (ESI) database comprising 499 highly cited papers and 16 hot papers in the field. The distributions of document type, language of publication, scientific output, and publication of journals are reported in this paper. The co-authorship network visualization of authors, organizations and countries, co-occurrence network visualization of all keywords are visualized using VOSviewer software. The 501 papers, all written in English language, were from 1,579 authors employed at 680 organizations based in 59 countries/territories. The papers were published in 40 journals in the field. The top 5 core journals ranked based on the impact factor (IF) were MIS Quarterly, Journal of the American Medical Informatics Association, International Journal of Information Management, Journal of the Association for Information Science and Technology, and Information Management. The top 5 organizations were University of Maryland (USA), University of Wolverhampton (UK), Vanderbilt University (USA), Indiana University (USA), and Wuhan University (China). Authors from the following countries contributed the most - USA, People's Republic of China, England, Canada and Netherlands. Based on network map using VOSviewer, there were micro, meso and macro level collaborations based on common interests in a specific topics. Analysis of all keywords showed that the research were distributed into 6 clusters. This study concludes that one important characteristic of top papers is the journal reputation, therefore authors can choose their ideal journal with a high JIF and quartile to publish papers in the English language related to this research field.

Keywords: Bibliometrics; Essential Science Indicators; Information Science; Library Science; Highly-cited papers; Hot papers.

INTRODUCTION

Top performing articles for citation impact in a particular field may be determined using the Essential Science Indicators (ESI), where these top papers are flagged as either hot papers or highly cited papers in Clarivate Analytics' Web of Science (WoS) database. Highly cited papers are papers that have received enough citations to place them in the top 1% when

compared to all other papers published in the same year in the same field[1]. Whereas, hot papers are receiving citations quickly after publication - these are the papers published in the past two years that received a number of citations in the most recent two-month period to place them in the top 0.1 % of papers in the same field. This total discounts duplicates, so that a paper that is both hot and highly cited is counted only once. Highly cited papers serve as a proxy for excellence, and in this vein, Dorta-González and Santana-Jiménez (2019) conducted a large-scale bibliometric analysis of the top 1% most cited research and characterized the highly cited articles. To provide an overview of the characteristics of research in China, a bibliometric evaluation of highly cited papers with high-level representation was conducted during the period from 1999 to 2009 based on the ESI database (Fu et al. 2011). Noorhidawati et al. (2017) identified Malaysian highly cited papers and explored the characteristics of these papers. While bibliometric and mapping of top or high impact papers in the science disciplines are common (Chaparro-Domíngue and Repiso 2020; Chuang, Wang and Ho 2011; Daud et al. 2020; Shi et al. 2020; Yang et al. 2020; Yuan and Sun 2019; 2020), studies characterizing highly cited papers in the social science disciplines have become quite widespread, for example, in the field of Economics and Business (Zhang et al. 2018); and Library and Information Science (LIS) (Bauer, Leydesdorff and Bornmann 2016). There are other description for highly cited papers, such as, publications receiving 100 or more citations are considered as highly (or top) cited articles (Elango and Ho 2018; Ivanović and Ho 2019). Stavropoulou, Somai and Ioannidis (2019) defined extremely highly cited papers as papers receiving more than 1,000 citations.

Bibliometric analysis is a method assessing the status and trends of a particular research field and thus providing ideas and directions for future research. Bibliometric technique and tools have been adopted in mapping of the world research and analysing top papers (Yuan and Sun 2020); identifying macro-level collaboration network and visualization with ESI (Yang et al. 2020); analysing scientific collaboration (Jabeen et al. 2017) and analysis of art exhibit reviews (Wang and Ho 2017). VOSviewer, intended primarily for analyzing bibliometric networks, is a software tool for creating maps based on network data and for visualizing and exploring these map, and can be used to construct networks of scientific publications, scientific journals, researchers, research organizations, countries, keywords, or terms. VOSviewer is also used to visualize the global scenario of authors, organizations and countries.

The purpose of this paper is to use bibliometric methods to analyze ESI papers in WoS subject category of Information Science and Library Science during 11 years period (2009 to 2019). According to WoS category description in the scope notes of Social Science Citation Index (SSCI), "Information Science & Library Science" covers resources on a wide variety of topics, including bibliographic studies, cataloguing, categorization, database construction and maintenance, electronic libraries, information ethics, information processing and management, interlending, preservation, scientometrics, serials librarianship, and special libraries. In this subject category (refered hereafter as Library and Information Science, LIS), research articles listed in the ESI are top papers and undoubtedly are of important significance. Analysis of LIS top papers through analyzing their publication year, category, journals, author, affiliations, country, all keywords and other key features would gain a deeper understanding on research performance of this research discipline. Co-authorship network visualization of author, organizations and countries, co-occurrence network visualization and overlay visualization of all keywords are done by VOSviewer.

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[1] https://clarivate.libguides.com/esi

MATERIALS AND METHOD

This study used Clarivate Analytics's WoS scientific citation search and analytical information platform - a research tool supporting a broad array of scientific tasks across diverse knowledge domains as well as a dataset for large-scale data-intensive studies - and the ESI, an analytical tool that helps identify top-performing research in WoS. Built, on the foundation of WoS, ESI is a unique compilation of performance statistics and trends extrapolated from counts of articles published in scholarly journals and the citations to those articles. In ESI, a journal can be assigned to only one field. When used, the ESI database has been updated as of March 12, 2020,to cover an 11 year period of January 1, 2009 – December 31, 2019. Data are updated bi-monthly (six times a year). This is the sixth (and the last) bi-monthly update of 2019. Papers counts for ESI are derived from the Science Citation Index Expanded (SCIE) and Social Sciences Citation Index (SSCI) only. Papers are defined as regular scientific articles and review articles.

A multi-level bibliometric information retrieval was performed on the WoS platform subscribed by the university library. It was completed on the single day on April 22, 2020 to avoid the bias caused by daily updating open database. We first conducted a search on WoS using the following query:
(WC=Information Science & Library Science) AND (PY=2009-2019) AND (DT=Article or Review).
(The search is restricted to the Article or Review document type in the WoS Core Collection).

Then, the results were refined by top papers including highly cited papers and hot papers. A total of 501 papers were retrieved which made up the data of the study, and the full record and cited references of the included papers were extracted and imported into VOSviewer (developed at Leiden University's Centre for Science and Technology Studies (CWTS) Leiden, The Netherlands) for further citation analysis. The "analyze results" option allows ranking the records by fields according to the record count or the selected field. The following field ranks were obtained: document type, language, output, subject category, journal, author, organization, country, and keywords. The trend of citations were all analyzed. Figure 1 presents the overall process of the research flow for this study.
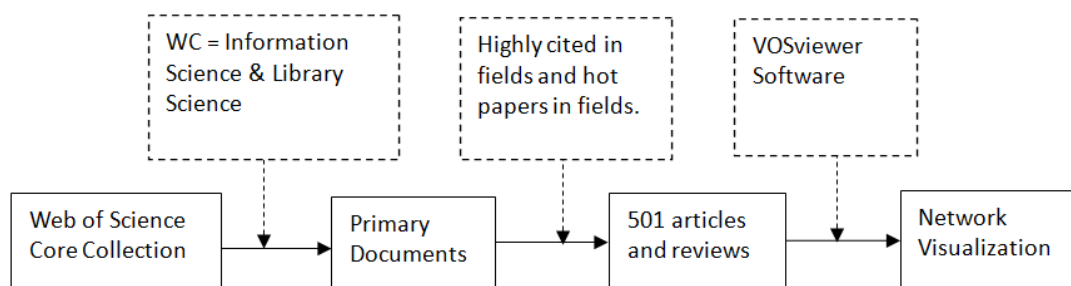

Figure 1: The Overall Process of The Research Flow to Retrieve the Data for this Study.

The analysis was completed with networking maps to provide values for international collaboration and the hotspots trends in LIS top papers. The network maps show international collaboration between different authors, countries, organizations and keywords. In this work, we used VOSviewer version 1.6.15 released on April 2020 to show the international collaboration between the authors, organizations, countries and the research trends through all keywords. VOSviewer, a tool for bibliometric mapping (Van Eck

and Waltman 2010) has been widely used in scientometrics studies such as in analyzing scientific collaboration in a given discipline (Jabeen et al. 2017); mapping of world research (Sun and Yuan 2020); mapping of top papers in a given discipline (Castillo-Vergara, Alvarez-Marin and Placencio-Hidalgo 2018; Yuan and Sun 2019; Yuan and Sun 2020); as well as in social networking and academic performance (Doleck and Lajoie 2018); bibliometric visualization and analysis of mapping knowledge domain (Shi, Miao and Si 2019) and wealth inequality (Korom 2019); and bibliographic coupling and co-citation analyses (Ferreira 2018).

RESULTS AND DISCUSSIONS

Publication Output, Document Type and Language of Publication

The 501 LIS top papers comprise 16 hot papers and 499 highly cited papers, which means that 14 hot papers are also highly cited papers. The 501 top papers were all covered in the SSCI, of which 302 papers were also indexed in SCIE, 7 papers from Conference Proceeding Citation Index Social Science and Humanities (CPCI-SSH), 5 papers from Conference Proceeding Citation Index Science (CPCIS), and 2 papers from the Arts and Humanities Citation Index (AHCI). Figure 2 presents the number of top papers and citations based on the year of publication, thus indicating the growth of in the number of LIS top papers since 2009. The mean publication was 45.55 paper per year, and the highest number of the top paper published is 58 in 2017. Total citations each year were power increased from 2009 to 2019.
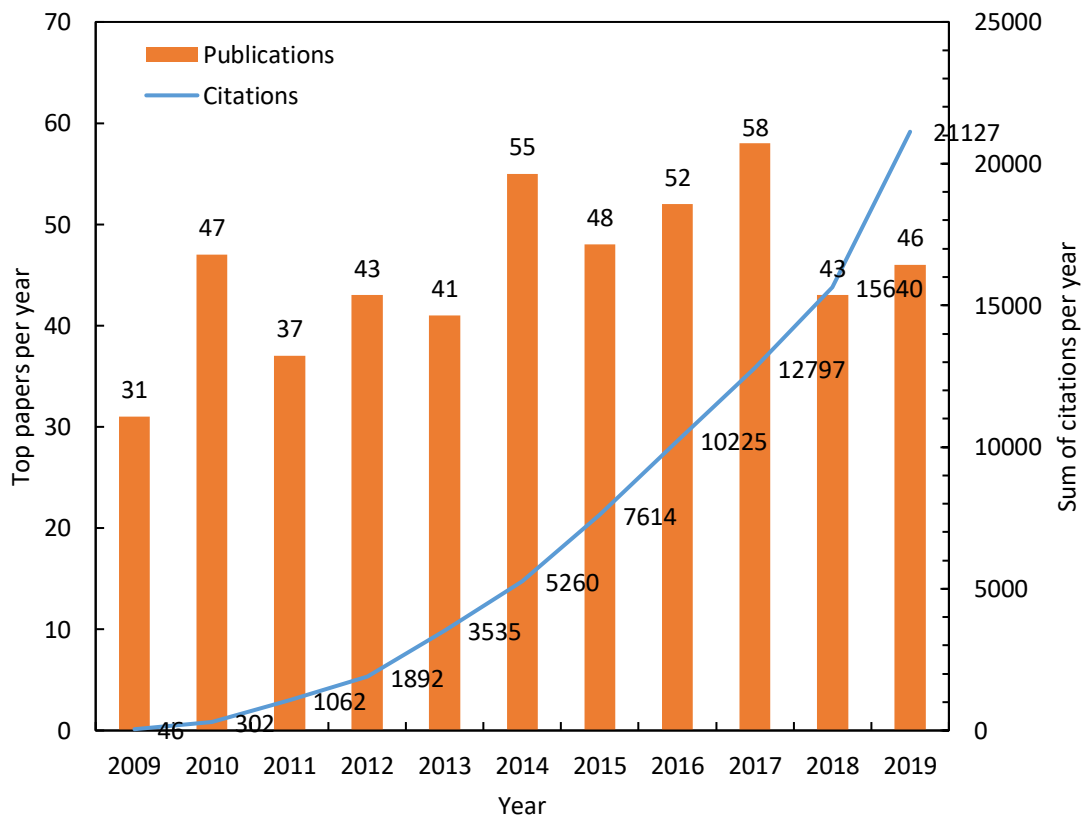

Figure 2: The Number of LIS Top Papers and Citations based on the Year of Publication

In the ESI database, papers are defined as regular scientific articles and review articles. When analysed by document type, most of the top-performing papers were articles (84.6%;

424) and the rest were review papers (15.4%; 77). All of the papers were published in the English language.

Web of Science Categories and Research Areas

Journals and books covered by WoS Core Collection are assigned to at least one WoS category. Each article indexed by WoS belongs to one or more subject categories. When analysed by subject categories and research areas, it is found that there is a total of 17 WoS subject categories assigned to the "Information Science & Library Science" top papers, and 14 research areas (Table 1). The top six subject categories are *Information Science Library Science* (501 papers, 100%), *Computer Science Information Systems* (259, 51.70%), *Management* (139, 27.75%), *Computer Science Interdisciplinary Applications* (119, 23.75%) and *Health Care Sciences Services* as well as *Medical Informatics* (65, 12.97% respectively). The top six research areas are *Information Science Library Science* (501 papers, 100%), *Computer Science* (313, 62.48%), *Business Economics* (139, 27.75%), *Health Care Sciences Services* and *Medical Informatics* (65, 12.97% respectively), and *Communication* (31, 6.19%. One thing should be noticed that LIS journals and articles may be classified in two or more categories in WoS, reflecting the multidisciplinary character of this research field (Elango and Ho 2018).

Table 1: Web of Science Categories and Research Areas for Information Science & Library Science Top Papers (2009-2019)

Rank	WoS Categories	No of papers	% of 501	Research areas	No of papers	% of 501
1	Information Science Library Science	501	100.0	Information Science Library Science	501	100.0
2	Computer Science Information Systems	259	51.68	Computer Science	313	62.48
3	Management	139	27.75	Business Economics	139	27.75
4	Computer Science Interdisciplinary Applications	119	23.75	Health Care Sciences Services	65	12.97
5	Health Care Sciences Services	65	12.97	Medical Informatics	65	12.97
6	Medical Informatics	65	12.97	Communication	31	6.19
7	Communication	31	6.19	Geography	27	5.39
8	Geography	27	5.39	Physical Geography	27	5.39
9	Geography Physical	27	5.39	Social Sciences Other Topics	16	3.19
10	Social Sciences Interdisciplinary	14	2.79	Biomedical Social Sciences	7	1.40
11	Social Sciences Biomedical	7	1.40	Telecommunications	2	0.40
12	Telecommunications	2	0.40	Education Educational Research	1	0.20
13	Education Educational Research	1	0.20	History	1	0.20
14	Ethics	1	0.20	Philosophy	1	0.20
15	History	1	0.20			
16	History of Social Sciences	1	0.20			
17	Philosophy	1	0.20			

Core Journals

Analysis of journals is an interesting aspect in this study, because it helps to identify the most possible journals that show the greatest impact to publish relevant studies in the field of LIS. Based on the Journal Citation Report (JCR) 2019 data, there are a total of 87 journals in the SSCI edition for Information Science & Library Science subject category. The 501 top LIS papers were published in 40 journal titles. The journals were ranked taking into account

the number of top papers they have, and Table 2 identifies 13 core journals having at least 10 top papers, the impact they received as well as their ranking position in JCR in the context of their field. In total, these 13 journal published 424 top papers, i.e. 84.6 percent of all top LIS papers from 2009-2019. They are all in the first quartile of JCR 2019, except for the *Journal of the Association for Information Science and Technology* (JASIST) (41, 8.184 %) which is ranked 30 out of 87 journals and is in Quartile 2.

Table 2: Top 13 WoS-indexed Journals Publishing Information Science & Library Science Top Papers (2009-2019)

Rank	Journal Titles	No of papers	% of 501	JIF 2019	5 year IF	Quartile	Rank (/87)
1	MIS Quarterly	68	13.57	5.370	9.921	Q1	2
2	Journal of the American Medical Informatics Association	65	12.97	4.112	4.327	Q1	12
3	International Journal of Information Management	62	12.38	8.210	8.690	Q1	1
4	Journal of the Association for Information Science and Technology	41	8.18	2.410	3.166	Q2	30
5	Information Management	30	5.99	5.155	6.714	Q1	5
6	International Journal of Geographical Information Science	27	5.39	3.733	3.710	Q1	16
7	Scientometrics	27	5.39	2.867	3.073	Q1	21
8	Telematics and Informatics	22	4.39	4.139	4.454	Q1	11
9	Information Systems Research	21	4.19	3.585	5.634	Q1	18
10	Journal of Computer Mediated Communication	20	3.99	5.366	6.273	Q1	3
11	Journal of Informetrics	18	3.59	4.611	4.410	Q1	9
12	Government Information Quarterly	13	2.59	5.098	6.411	Q1	6
13	Information Processing Management	10	1.99	4.787	4.278	Q1	7

The top 3 journals and top 5 journals published about 38.92 percent and 53.09 percent of the total top papers, respectively. *MIS Quarterly* was the most productive journal with 68 top papers (13.57%), followed by *Journal of the American Medical Informatics Association* (65, 12.97%), *International Journal of Information Management* (62, 12.38%), *Journal of the Association for Information Science and Technology* (41, 8.18%), *Information Management* (30, 5.99%). These five journals published more than 30 top papers each.

Of the 40 journals publishing LIS top papers, 20 titles (413 papers; 82.44%) are in the first quartile, and 17 titles (84 papers, 16.77%) are in the second quartile. One can conclude that there are more top papers come from journals with higher impact factor and higher JIF quartile rank in a particular subject category. This finding also reflects that there are more top papers published in the English language coming from journals with higher impact factor, rank and quartile in the relevant subject category. However, it should be noted that journal impact ascertained from citation analysis is not a measurement of scientific quality, but is reflective of its importance (White-Gibson et al. 2019).

Authors Co-authorship Analysis
Collaboration among researchers, research institutions and countries play a pivotal role in contemporary science. Internationally collaborative articles have the highest visibility and scientific impact followed by inter-institutional collaborative articles, single-country articles and single-author articles, respectively (Wambu and Ho 2016). The most common kind of collaboration network is the co-authorship network.

The network visualization of authorship in the field of Information Science & Library Science is shown in Figure 3. Each circle (or node) represents an author, and the size of the circle indicates the number of papers published. The link connecting two circles stands for the cooperative relation between two authors, and the thickness of the link represents the intensity of cooperation. Authors with a minimum productivity of 2 publications were visualized in Figure 3 using network visualization map that showed research networking among active authors. Of the 1,579 authors producing top LIS papers, there were 187 authors who met the thresholds, but only 17 authors were connected to each other. Circles denoting authors who are in the same cluster suggested that the authors studied in a similar field and had close cooperation with each other.
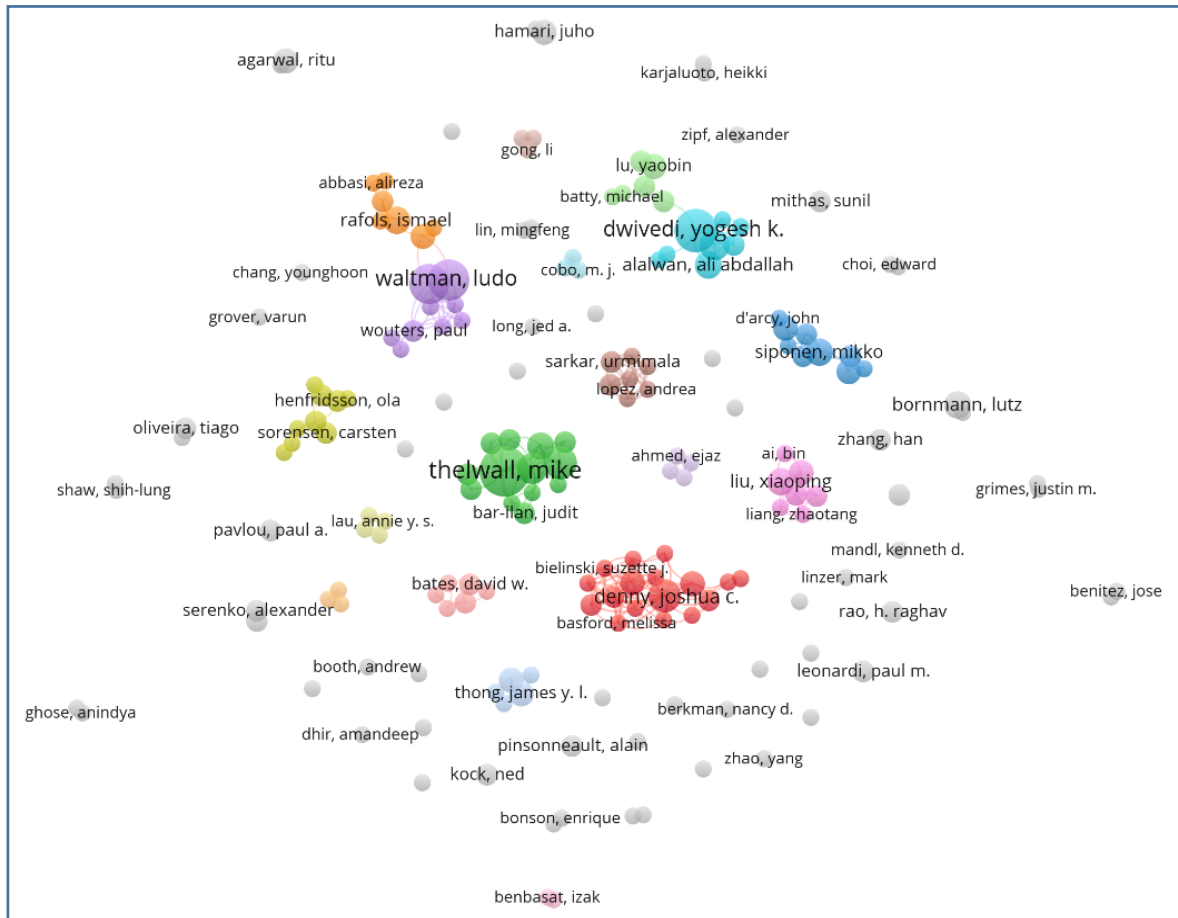

Figure 3: Network Visualization Map of Top Authors Publishing Information Science and Library Science Top Papers (2009 to 2019)*
(*Cooperation based on co-authorship between authors. Network visualization map of authors with minimum productivity of 2 publications in the studied field and exist within a collaborative research group)

The largest cluster in Figure 2 consisted of 17 authors (marked in red color). The second cluster (green) consisted of 13 authors. The third cluster (blue) consisted of 9 authors. The fourth cluster (yellow) and the fifth cluster (violet) also consisted of 9 researchers each. The sixth cluster (shallow blue) consisted of 8 researchers. The seventh cluster (orange) consisted of 7 researchers.

The top 8 authors producing 6 or more top papers are Thelwall, Mike (University of

Wolverhampton), Dwivedi Yogesh K. (Swansea University), Waltman, Ludo (Leiden University), Van Eck Nees Jan (Leiden University), Denny, Joshua C. (Vanderbilt University School of Medicine), Sugimoto, Cassidy R. (Indiana University), Haustein, Stefanie (University of Ottawa), and Rana Nripendra P. (University of Bradford). The link strength between two circles refers to the frequency of co-authorship. It can be used as a quantitative index to depict the relationship between two circles. The total link strength of a circle is the sum of link strengths of this node over all the other nodes. Table 3 presents the top 8 authors who published 6 or more top papers and their total link strength, citations and average citations.

Table 3: The Top 8 Most Prolific Authors Publishing Top Papers in the Field of Information Science & Library Science (2009-2019)

Rank	Author	Cluster	No of top papers	Link strength	Total link strength	Citations	Avg. citations
1	Thelwall, Mike	2	16	11	21	2488	155.5
2	Dwivedi, Yogesh K.	6	12	7	17	944	78.7
3	Waltman, Ludo	5	11	7	20	2900	263.6
4	Van Eck, Nees Jan	5	10	7	20	2668	266.8
5	Denny, Joshua C.	1	7	15	32	893	127.6
6	Sugimoto, Cassidy R.	2	7	6	13	903	129.0
7	Haustein, Stefanie	2	6	8	15	601	100.2
8	Rana, Nripendra P.	6	6	5	14	587	97.8

Organizations Co-authorship Analysis

Organization co-authorship analysis reflects the degree of communication between institutions as well as the influential institutions in a research field (Reyes-Gonzalez, Gonzalez-Brambila and Veloso 2016). The contribution of different organizations was estimated by the institute of the affiliation of at least one author of the published papers. There were 680 organizations contributing the 501 top papers in this study. Table 4 lists the top 11 organizations that had published 9 or more top papers, and their total link strength, citations and average citations.

Table 4: Top 11 Organizations Publishing Top Papers in the Field of Information Science & Library Science (2009-2019)

Rank	Organizations	Cluster	No of top papers	Link strength	Total link strength	Citations	Avg. citations
1	University of Maryland	2	19	9	9	4467	235.1
2	University of Wolverhampton	1	16	3	5	2559	159.9
3	Vanderbilt University	3	12	13	20	1388	115.7
4	Indiana University	5	12	6	10	2388	199.0
5	Wuhan University	1	10	2	2	585	58.5
6	University of Montreal	1	9	3	6	2216	246.2
7	City University Hong Kong	2	9	3	3	1297	144.1
8	Temple University	2	9	3	3	2420	268.9
9	University of Wisconsin	2	9	6	6	1618	179.8
10	University of Michigan	3	9	5	5	1177	130.8
11	University of Washington	5	9	7	7	1370	152.2

The top 5 organizations were University of Maryland (19 papers), University of Wolverhampton (16 papers), Vanderbilt University and Indiana University (12 papers each), and Wuhan University (10 papers). Another six organizations (University of Montreal, City

University Hong Kong, Temple University, University of Wisconsin, University of Michigan and University of Washington had 9 top papers each.

Of the 680 organizations, there were 47 organizations that meet the thresholds of 5 top papers, but 7 organizations were not connected to each other. The organization co-authorship in the field of Information Science & Library Science is shown in Figure 4 covering 40 organizations. Each circle represents one organizations, the size of each circle represents the number of articles of each organization, denoting the activity of the organization. A line is established when two organizations have a collaborative relationship. The thickness of the each line reflects the tightness of cooperation and the number of collaborations between organizations; the closer the circles the closer the collaboration is.

Countries/Regions Co-authorship Analysis

The country affiliation provides information about the country in which the authors worked, within a certain research institution, at the time they were publishing their top papers. Each author of a top paper has made an independent contribution to the manuscript, therefore the country and institution the author affiliated to could be considered the important contributors for the evaluation of research output. There were altogether 59 countries contributing the 501 top papers in this study. Table 5 lists the top 10 countries/regions ranked by the number of top papers, and their total link strength, citations and average citations, with the USA being the largest contributor. Taiwan, as a region and province of People's Republic of China, shows strong research competence in the field of Information Science & Library Science.

Table 5: Top 10 Countries/Regions Publishing Top Papers in the Field of Information Science & Library Science (2009-2019)

Rank	Countries/Regions	Cluster	No of top papers	Link strength	Total link strength	Citations	Avg. citations
1	USA	4	255	24	136	47490	186.2
2	People's R China	1	63	18	66	8253	131.0
3	England	5	62	22	62	9538	153.8
4	Canada	4	41	12	36	8131	198.3
5	Netherlands	2	36	11	24	8013	222.6
6	Germany	2	26	9	22	4845	186.3
7	South Korea	1	25	10	21	3758	150.3
8	Spain	1	21	10	18	2866	136.5
9	Finland	3	19	8	20	2931	154.3
10	Taiwan	8	19	5	11	2540	133.7

The international country co-authorship network map using VOSviewer software is presented in Figure 5, with the circle representing a country/region. The size of each circle represents the number of articles published by each country, which denotes the research activity of the country/region. A line is established when two countries/regions have a collaborative relationship. The thickness of the each line reflects the tightness of cooperation and the number of collaborations between countries/regions. A threshold of 5 top papers was set and there were 30 countries/regions meeting the requirement. As seen from Figure 5, the top 5 countries - USA, People's Republic of China, England, Canada and Netherlands - had the biggest nodes.
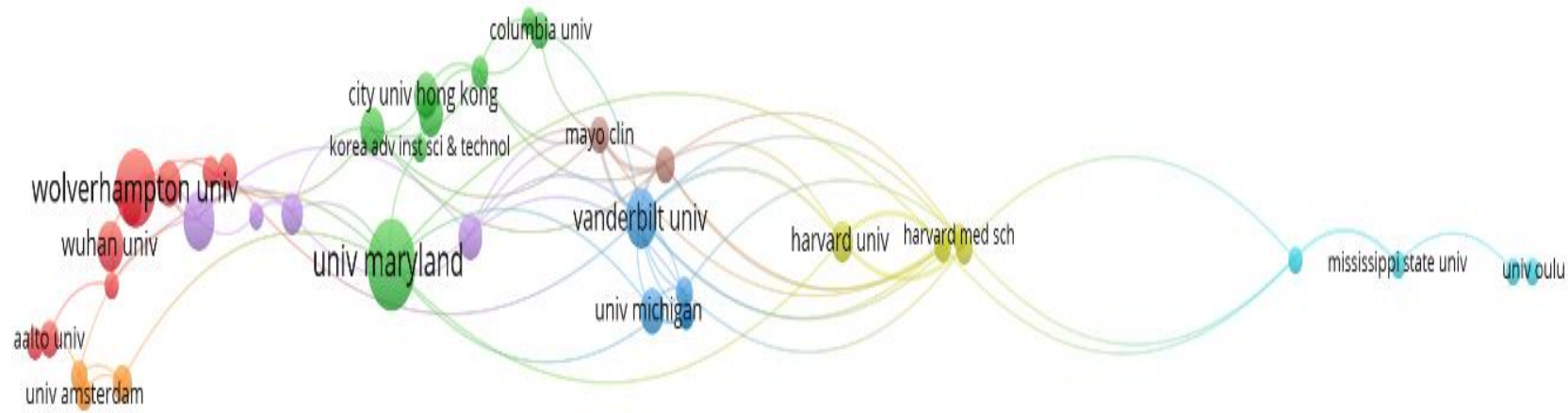
Figure 4: The Organizations Co-Authorship Network of Top Papers in Information Science & Library Science (2009 to 2019)*.

*The Organizations Co-Authorship Network comprises 40 organizations
The VOSviewer software divided these 40 organizations into 8 clusters with different colors.
The 8 clusters have 10 (red in color), 8 (green), 5 (blue), 4 (yellow), 4 (violet), 4 (shallow blue), 3 (orange), and 2 (brown) organizations respectively.
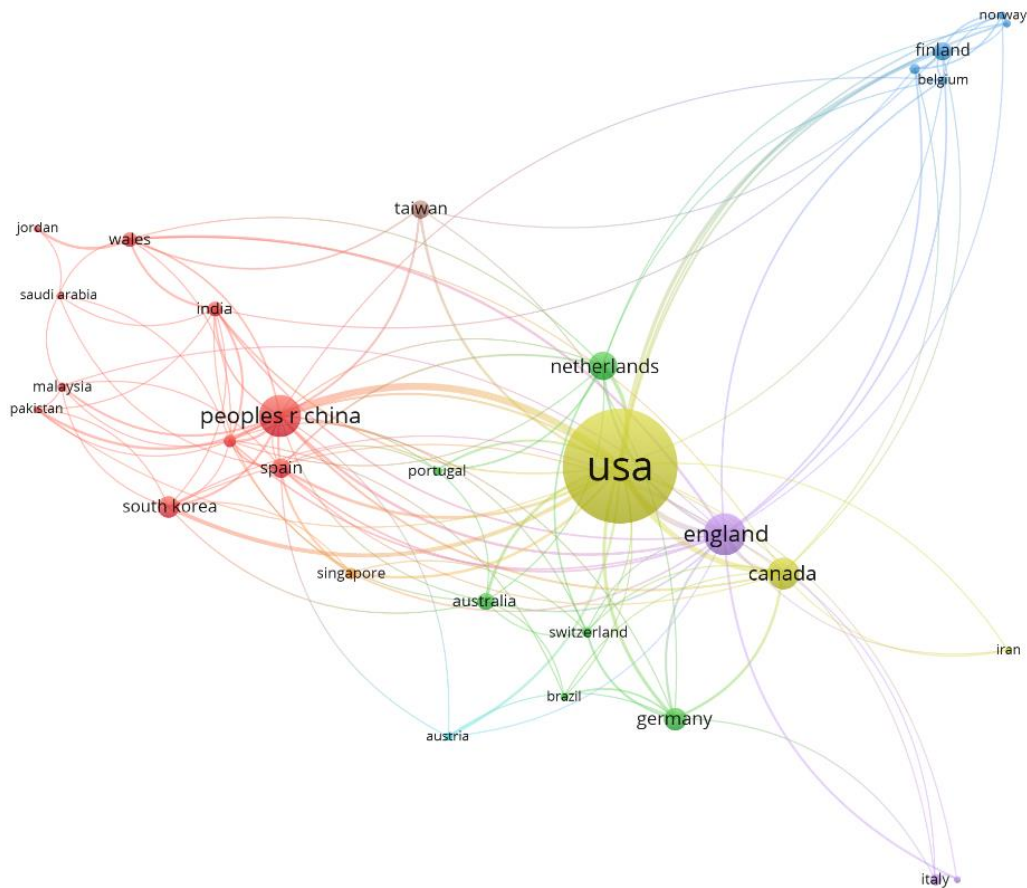
Figure 5: The Country Co-authorship Network of Top Papers in Information Science & Library Science (2009 to 2019)*

(The country co-authorship network map with 30 circles (nodes) and 8 clusters, the bigger nodes represented the more influential countries in this field. The distance and thickness of links represented the degree of cooperation among countries. The VOSviewer software divides these 30 nodes into 8 clusters. The different colors group show the different clusters formed by sets of countries. One color represents one cluster).

Eight clusters were found among the 30 countries. The first cluster consisted of 10 countries and regions (marked in red color), People's Republic of China, South Korea, Spain, India, Wales, France, Malaysia, Jordan, Pakistan, and Saudi Arabia. The second cluster (green) consisted of 6 countries - Netherlands, Germany, Australia, Switzerland, Portugal, and Brazil. The third cluster (blue) consisted of 5 countries - Finland, Denmark, Belgium, Norway, and Sweden. The fourth cluster (yellow) comprised 3 countries and regions namely USA, Canada, and Iran. The fifth cluster (violet) also comprised 3 countries - England, Italy, and Scotland. There was only one country in the sixth(shallow blue color), seventh (orange color) and eighth (brown color) cluster respectively, namely Austria, Singapore, and Taiwan. More cooperation could bring more advanced achievements in scientific research, therefore, geographical location is an important factor that determines international cooperation. The countries/regions co-authorship analysis showed that the USA was the center of connection and closely cooperated with many countries, such as England, People's Republic of China, Netherlands, Canada, Germany, South Korea, Spain, Finland, Australia, and Italy, reflecting that increasing international exchanges have promoted academic communications (Tang et al 2018).

Keywords Co-occurrence Analysis

Figure 6 shows the network map that links the keywords to the entire sample of the top papers analyzed. All 2,981 keywords were analyzed by VOSviewer software. Keywords that appeared more than 5 times, with a count of 215, were included in the map. For the keywords map, full counting method was used, meaning that each co-occurrence link carried the same weight. The default "association strength method" was used for normalization of the co-occurrence matrix with default values of attraction and repulsion. The size of the circle represents the number of articles in which each keyword appears and the color represents the cluster in which the keyword is included based on the number of co-appearances. In general, the larger the size of a circle is, the more frequently the keyword appears. A small distance between two keyword terms represents that a large number of co-occurrences of the terms. VOSviewer divided the keywords into 6 main clusters that represent 6 groups of research topics on Information Science & Library Science. Further analysis listed and ranked the top 20 keywords in each cluster.
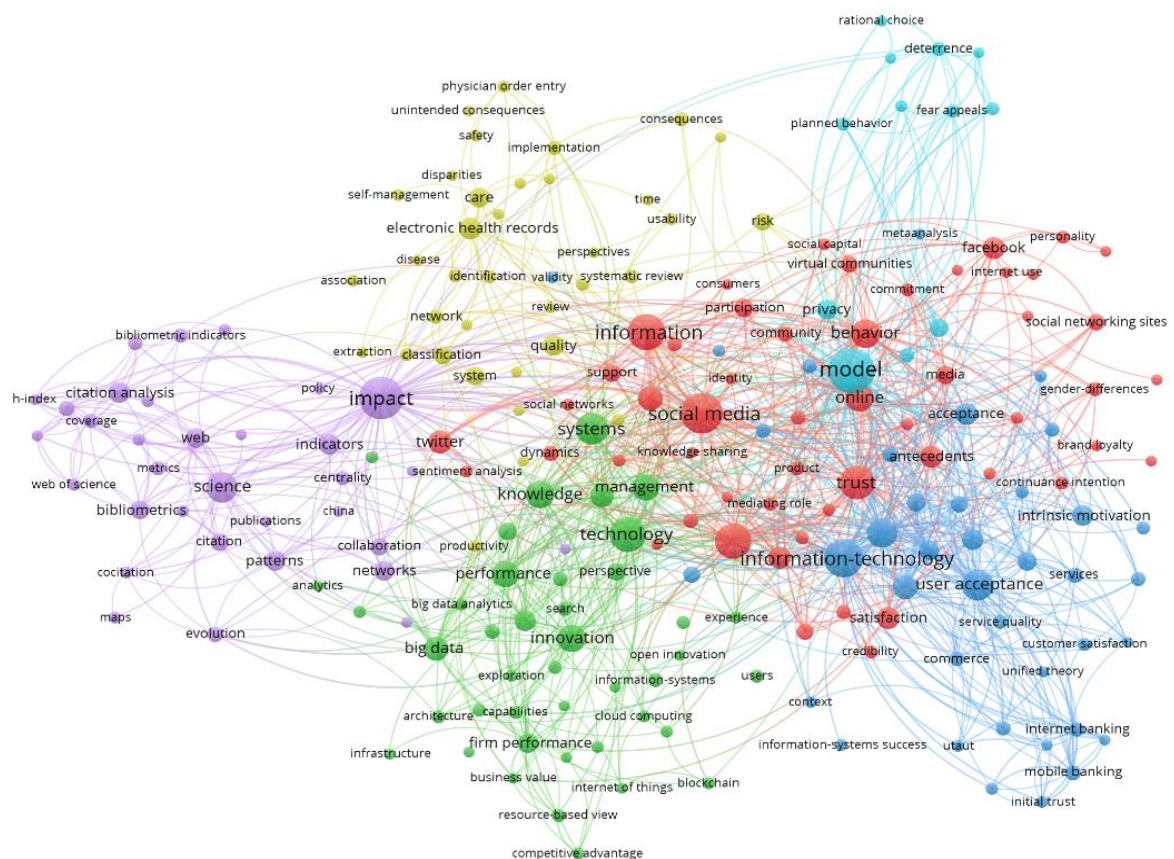

Figure 6: VOSviewer Co-occurrence Network Visualization Mapping of Most Frequent Keywords (minimum of 5 occurrences) in Top Papers in Information Science & Library Science (2009 to 2019)*

(*Co-occurrence network of all keywords including author keywords and keywords plus)

The first cluster (marked in red) focuses on social media information as a research topic, and includes 20 keyword terms such as social media, information, Internet, trust, behavior, online, communication, Twitter, antecedents, word-of-mouth, facebook, satisfaction, media, participation, support, electronic commerce, social networking sites, virtual communities, community, and dynamics.

The second cluster (green) represents the technology innovations a research topic. The 20 keyword terms ranked are technology, systems, innovation, knowledge, management, performance, big data, design, framework, firm performance, knowledge management, perspective, challenges, strategies, information systems, search, architecture, capabilities, organizations and resource-based view.

The third cluster (blue) is focused on information technology, including the following keyword terms such: information technology, user acceptance, adoption, determinants, acceptance, intention, intrinsic motivation, e-commerce, perceptions, technology acceptance model, literature review, technology adoption, mobile banking, services, usage, commerce, common method variance, e-government, internet banking, and perceived ease.

The fourth cluster (yellow) represents electronic health records as a research topic. The 20 keyword terms ranked are electronic health records, quality, care, system, classification, risk, network, consequences, implementation, systematic review, decision-making, identification, natural language processing, validation, association, diffusion, physician order entry, productivity, safety, and self-management.

The fifth cluster (violet) focuses on impact and citation analysis, and includes 20 keyword terms namely impact, science, citation analysis, indicators, networks, patterns, web, bibliometrics, citation, collaboration, evolution, Scopus, centrality, bibliometric indicators, citations, coverage, metrics, altmetrics, cocitation, and index.

Finally, the sixth cluster (shallow blue) has less than 20 keywords and is focused on information modelling, and the keyword terms ranked are model, privacy, self-efficacy, deterrence, motivation, fear appeals, planned behavior, protection motivation theory, protection motivation, computer abuse, information security, and rational choice.

Most Cited Articles

The total citation count was obtained from WoS Core Collection, and this shows the total number of times that a particular article was cited by the journals listed in the SCIE database. Although a great many articles have been published, a relatively small number of individual authors account for a large proportion of the citations within the period. Table 6 shows the top papers that have garnered a total citation of more than 1,000 times since their initial publication to April 22, 2020, revealing a total of six publications. Three of the top papers were published in *MIS Quarterly,* and one each from *Health Information and Libraries Journal, Information Processing & Management,* and *Scientometrics.*

The annual citations of the six top papers shows a trend to increase during their citation history after the publication year that is over the cited half-life of about 5-6 years based on JCR 2019. The time dependence of a single paper is called its history. In the beginning year (or zero year), this was lower because all papers appeared in that published year. From Figure 7, it can be found that the citation per year of the papers increased till to 2019, but the increase rate is different for various papers.

Table 6: Top 6 highly cited papers with total citations more than 1,000 times.

Rank	Title / (Author)	Journal title	PY	Vol. P	TC	APY
1	Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology (Venkatesh, Viswanath; Thong, James Y. L.; Xu, Xin)	*MIS Quarterly*	2012	36(1) 157-178	1822	202.44
2	Business intelligence and analytics: from big data to big impact (Chen, Hsinchun; Chiang, Roger H. L.; Storey, Veda C.)	*MIS Quarterly*	2012	36(4) 1165-1188	1470	163.33
3	A typology of reviews: an analysis of 14 review types and associated methodologies(Grant, Maria J.; Booth, Andrew)	*Health Information and Libraries Journal*	2009	26(2) 91-108	1451	120.92
4	Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration(Wetzels, Martin; Odekerken-Schroder, Gaby; van Oppen, Claudia)	*MIS Quarterly*	2009	33(1) 177-195	1337	111.42
5	A systematic analysis of performance measures for classification tasks(Sokolova, Marina; Lapalme, Guy)	*Information Processing & Management*	2009	45(4) 427-437	1200	100
6	Software survey: vosviewer, a computer program for bibliometric mapping(van Eck, Nees Jan; Waltman, Ludo)	*Scientometrics*	2010	84(2) 523-538	1180	107.27

Note: PY: Publication year; TC: Total Citations; Vol. P: volume (issue) page ; APY: Average per year.
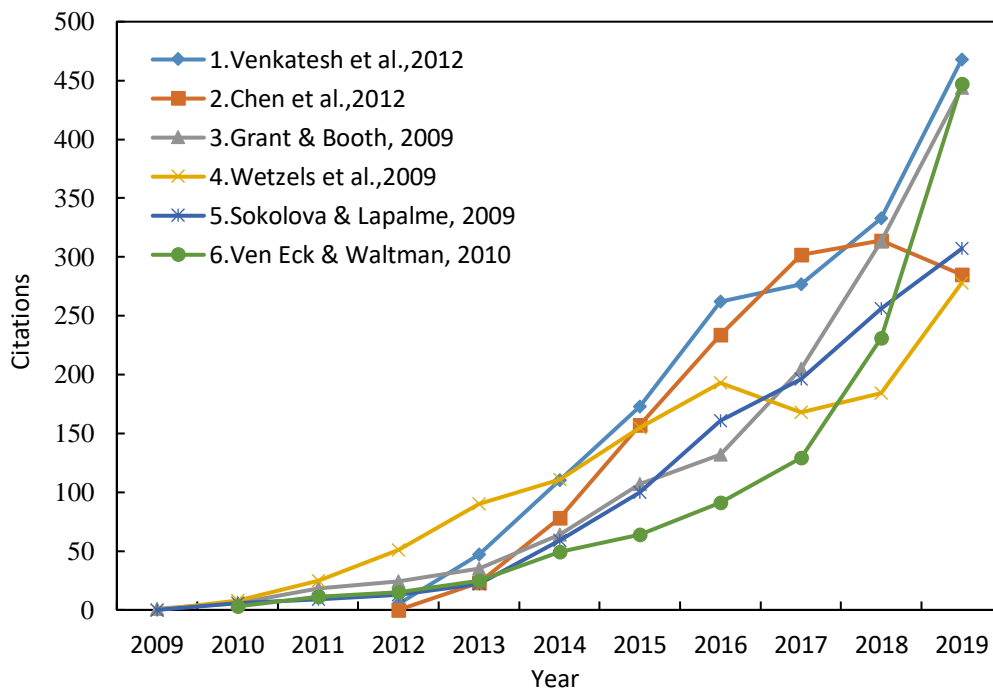

Figure 7: Comparison of the Citations of the Six Top Papers from their Initial Publications to April 22, 2020

CONCLUSION

The 501 LIS top papers for a ten year period (2009-2019) comprised 499 highly cited papers and 16 hot papers included in the WoS subject category Information Science & Library

Science. Results showed that these papers, all written in English, were from 1,579 authors, 680 organizations and 59 countries/territories, listed in 40 journals in the field of Information Science & Library Science. The analysis of network map using VOSviewer showed the international collaborative nature of top papers at the micro, meso and macro level based on common interests in a specific topic. The analysis of all keywords showed that the LIS top papers were distributed into six research topics namely social media information, technology innovations, information technology, electronic health records, impact and citation analysis, and information modelling. This work demonstrates that there are more top papers coming from journals with higher impact factor and higher rank in the subject category. This study concludes that one important characteristic of top papers is the journal reputation, therefore authors can choose their ideal journal with a high JIF and quartile to publish papers in the English language related to this research field. This study is descriptive and focuses on the top LIS papers only, therefore, the results are of limited generalisability.

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